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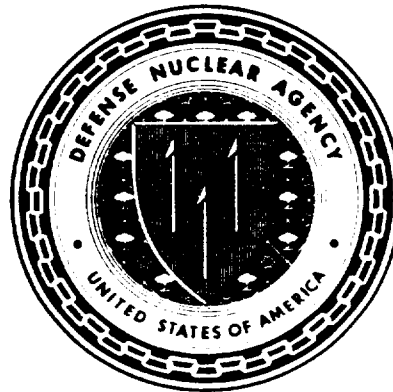
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CASTLE SERIES

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United States Atmospheric Nuclear Weapons Tests
Nuclear Test Personnel Review

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) CASTLE was an atmospheric nuclear weapons test series held in the Marshall Islands at Enewetak and Bikini atolls in 1954. This is a report of DOD personnel in CASTLE with an emphasis on operations and radiological safety.		

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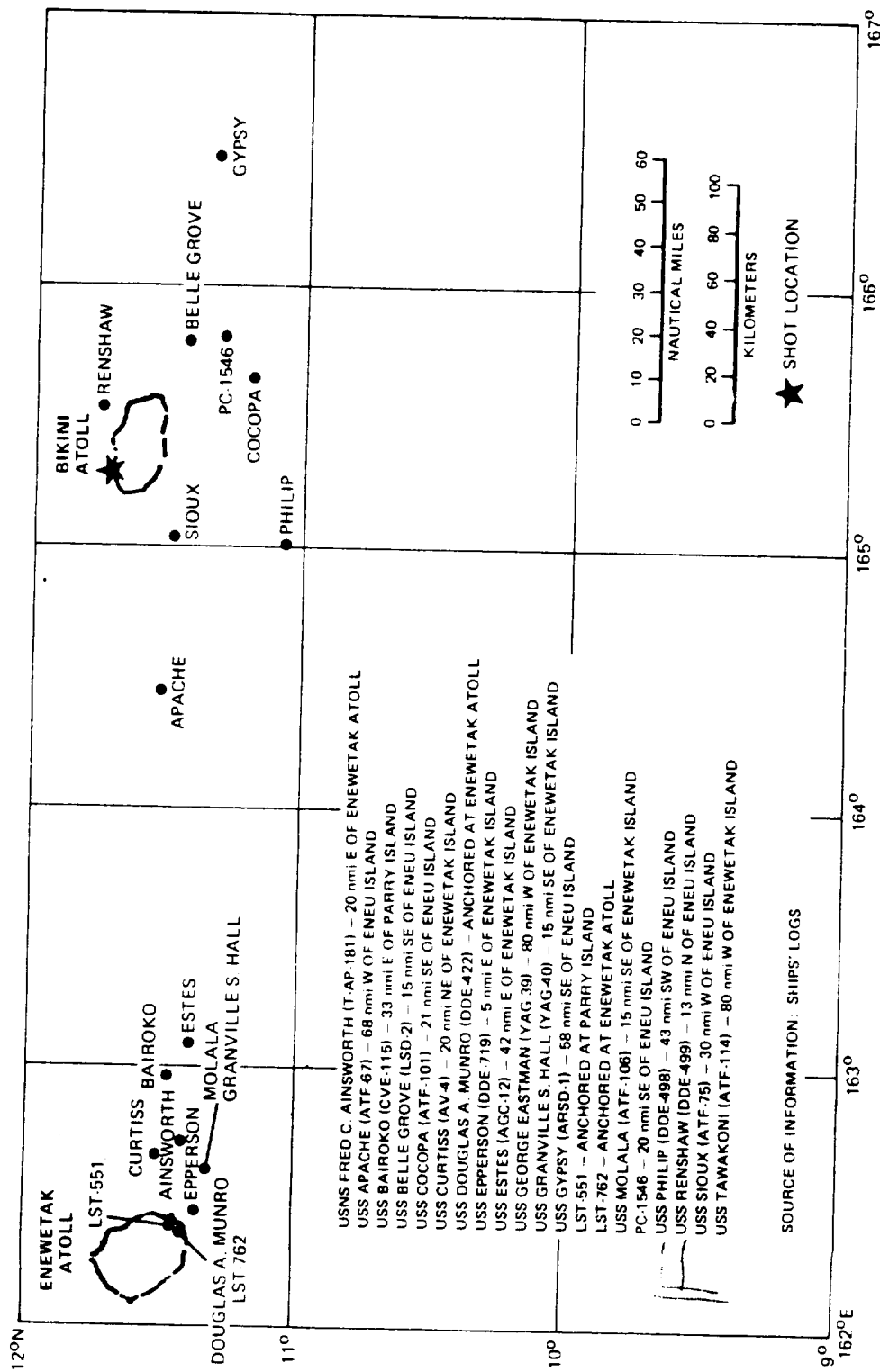


Figure 65. Ship positions on 2 March, 24 hours after CASTLE, BRAVO.

boats for additional hosing after the first hosings. Average intensity was down to 0.002 R/hr by 22 March (Reference 80).

The location of the fleet 48 hours after BRAVO is shown in Figure 66. At 0830 on 3 March, the Bairoko reentered Bikini Lagoon and anchored off Eneu. Helicopters operated throughout the day from the flight deck on postponed data-recovery and other missions. The helicopters landed in a canvas "bathtub" on the carrier's deck if they had been to an island station where they could have collected radioactivity on their wheels. This bathtub prevented washwater containing the contaminants from flowing onto the flight deck (Reference 32).

Some flight deck drains were still clogged and "hot" from the BRAVO washdown. Readings were about 0.100 R/hr, with one as high as 0.500 R/hr. Crews unclogged drains throughout the day. Other spots, such as parts of the antiaircraft guns, were decontaminated by hand scrubbing and rinsing. Cocomat fenders and canvas were flushed to wash away contaminants, then located away from personnel to allow natural decay of residual radioactivity. Decontamination for the Bairoko was considered complete by the end of 4 March (Reference 32).

Contamination of Bikini lagoon water by radioactivity was considered a threat to fleet operations there after each shot. By 3 days after BRAVO, contaminants on the order of 1 microcurie per liter ($\mu\text{Ci/l}$) began to appear; following a buildup, however, the level of contamination began to fall after 10 days. Drinking water distilled from lagoon waters showed no significant radioactivity. Some radioactivity built up outside ship salt-water pumps, drains, and other installations. The highest noted reading of this kind was 0.030 R/hr on the outside of a condenser on the USS Curtiss (Reference 80).

EVACUATIONS

The TG 7.4 radsafe officer sent by the Commander, Test Services Unit WREP, along with two other WREP personnel, to determine the radiological

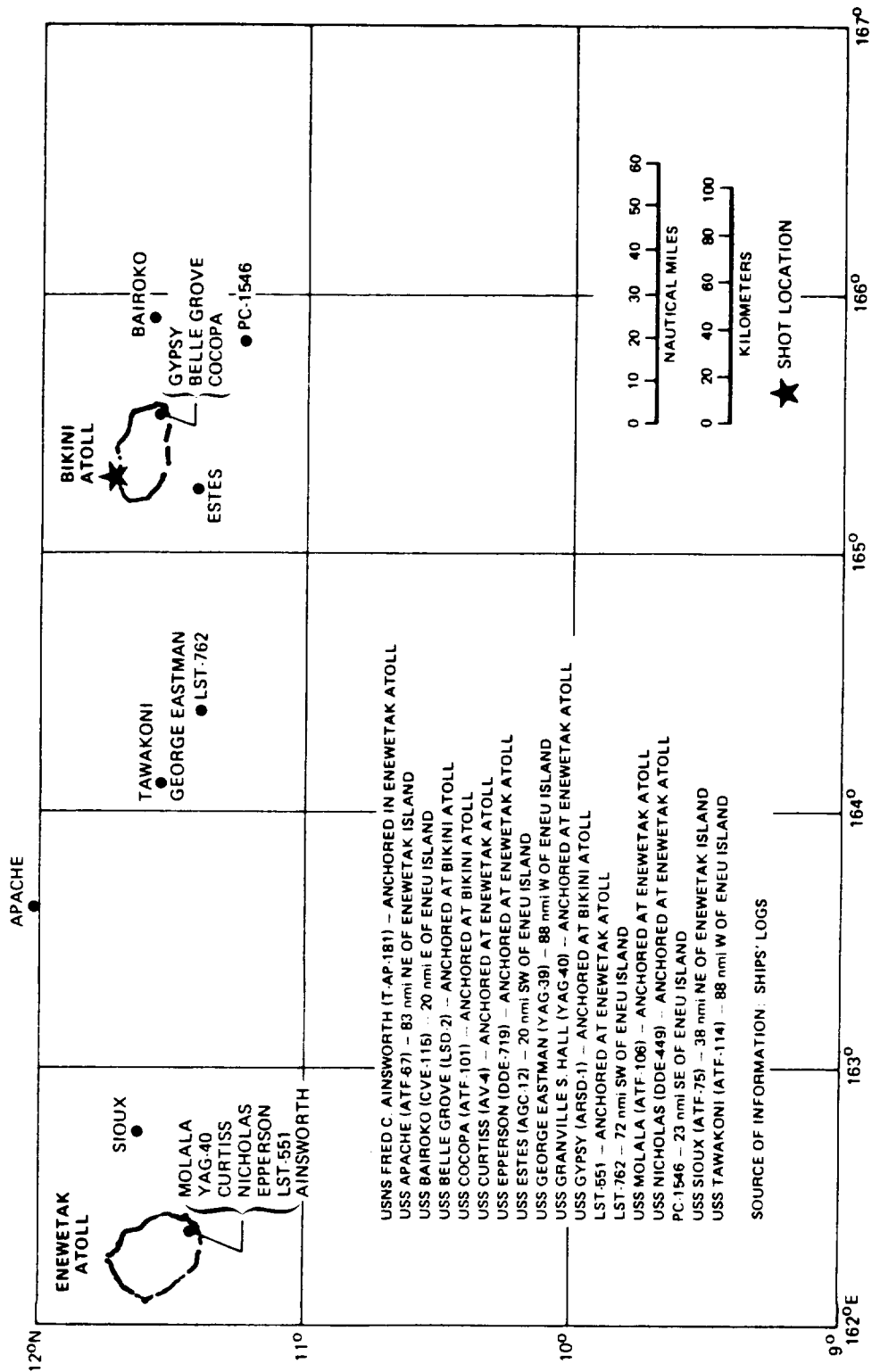


Figure 66. Ship positions on 3 March, 48 hours after CASTLE, BRAVO.

condition at Rongerik, left on the Navy UF-1 amphibian from Kwajalein at 0800 on 2 March. The aircraft was over Rongerik at 0945 and took flyover measurements of the occupied island of the atoll and then the entire atoll at altitudes of 500 feet (153 meters) and below. The readings were 0.200 R/hr at 500 feet (153 meters) and 0.350 R/hr at 25 feet (7.6 meters) (Reference 16, p. K-7).

The UF-1 then climbed to 5,000 feet (1.52 km) in an attempt to communicate directly with the Estes, then at Enewetak; the TG 7.4 radsafe officer wanted an additional amphibious airplane from Enewetak to aid in evacuation. Some garbled and ineffective transmissions ensued, followed by a message denying permission for evacuation and then one permitting it. The radsafe officer had decided to evacuate the island on the basis of his own evaluation of the local situation; it is not clear whether any or all of the Enewetak messages were received by the UF-1, which was descending to land in the lagoon at 1130.

On Rongerik, the radsafe officer quickly briefed the detachment personnel on what he knew, asked the warrant officer in charge to select eight men for evacuation, and made a hasty radiological survey with the following results (Reference 84):

1. Inside the building where the men spent most of their time (the reading, however, was regarded as low because the building had been hosed down thoroughly early in the morning): 0.6 R/hr
2. Outside the same building at waist height as taken in front of the building on the pierced steel planking platform: 1.8 R/hr
3. Beside the same building at the sand surface: 2.4 R/hr
4. Surface of a bed in a living tent: 1.2 R/hr.

At about 1230 the amphibian left the lagoon and arrived at Kwajalein at approximately 1400 with the eight evacuees and the three WREP representatives aboard. The men were taken in the alphabetic order of their last names.

Because no other amphibious aircraft were available, the same UF-1 and crew returned after a brief lunch at Kwajalein, where the cargo originally meant for Rongerik was offloaded. The UF-1 returned to Kwajalein at about 1830 with the remaining 20 men from Rongerik (Reference 84).

A conference was held at 1330 at which the task force radSAFE officer, the task force and task group commanders, and the Scientific Director reviewed what was known of the fallout situation. A decision had been made, albeit at the local level, to evacuate the U.S. personnel on Rongerik, and now the other atolls in the vicinity had to be considered.

As part of the offsite fallout monitoring program of the AEC Health and Safety Laboratory, postshot flights were conducted over all the Marshalls. Several patterns, designated Able, Baker and Charlie, were flown by VP-29. Able, a flight over the northern Marshalls, was underway on 2 March.

Before the conference was over, an inflight report from flight Able indicated 1.350 R/hr at 1340, 2 March, extrapolated to ground level at Rongelap Island, 0.400 R/hr at 1328 at Ailinginae, and 0.001 R/hr at 1300 at Wotho. It was decided that evacuation of Rongelap was necessary and that other islands likely to be involved would be determined from the readings of the remaining portion of the flight Able pattern (Reference 26).

Accordingly, the destroyer Philip left for Rongelap immediately. Instructions were issued to dispatch an Air Force SA-16 amphibian flight with two radSAFE monitors to check surface conditions at Rongelap before dark. The destroyer was directed to be off Rongelap ready to start evacuation at dawn the following day. A Trust Territory representative and an interpreter were requested to move by PBM seaplane from Kwajalein to arrive at Rongelap at the same time. The SA-16 flight was set up and the two monitors were especially briefed to make readings at waist height, to use several meters of the same type for comparison, and to use different types for cross-checking.

An average reading of 1.400 R/hr at approximately 1700 taken in the living area of Rongelap Island by these monitors supported the decision that same night to order the Philip to commence evacuation operations at dawn. Evacuation began about 0730, 3 March, and was completed by 1030. It developed that all the people on the atoll but away from the living area had returned home after BRAVO in order to discuss the unusual phenomena of the visible light and audible shock. This factor simplified evacuation by concentrating all natives on the home island of Rongelap.

Interrogation of the Rongelap people disclosed that all were present except for 18, who were fishing at Ailinginae. Following the Rongelap operation, the destroyer proceeded to Ailinginae, removed the remaining 18 and proceeded to Kwajalein. A total of 17 male and 20 female adults and 15 male and 14 female children were removed by destroyer and debarked at Kwajalein. An additional 16 old and sick were removed from Rongelap by PBM at about 0930 and flown to Kwajalein. All evacuees underwent decontamination procedures during the trip to Kwajalein, and again on Kwajalein (Reference 65).

The full report from flight Able, received at approximately 1900, 2 March, indicated Utirik ground contamination of 0.240 R/hr at 1651, 2 March, and contamination of 0.076 R/hr at about 1716, 2 March, at Ailuk, the nearest populated island to the south. Bikar, the nearest island to the north, was contaminated to about 0.600 R/hr at about 1628, 2 March, but was determined to be unpopulated. Taongi, the next nearest island to the north, showed 0.014 R/hr at 1525; it was also unpopulated. Based on these readings, another destroyer (the Renshaw) was sent to Utirik to anticipate an order for evacuation at dawn on 4 March. Meanwhile, a PBM flew monitors to Utirik on 3 March to conduct a ground survey while the destroyer was on the way. This ground survey, conducted similarly to that for Rongelap, indicated 0.160 R/hr at 1830, 3 March. The exposure of the Utirik people was computed at 58 R if they remained on the atoll.

The destroyer was subsequently ordered to start evacuation the following morning, 4 March. Between 1100 and 1300, 157 people were removed, underwent decontamination procedures on the destroyer en route to Kwajalein, and debarked on 5 March. Questioning of Utirik inhabitants disclosed that all had been evacuated. The destroyers evacuating Rongelap and Utirik were also directed to obtain drinking water samples from these atolls. A check of these samples indicated the drinking water contained from 2 to 28 times the task force standard allowance of radioactive contaminants (for full-time usage) (Reference 65).

The status of Ailuk Atoll, with a reported population of 401, came under consideration at approximately 2000 on 2 March. The expected dose without evacuation was determined to be less than 20 R, i.e., less than the standard used by the task force for its sampling aircraft crews. This was the major factor in the decision not to evacuate Ailuk. All other populated atolls on the flight Able pattern received less contamination than Ailuk (Reference 26).

During the afternoon of 2 March, a directive was issued to execute the offsite monitoring flights Baker and Charlie on 3 March. These flights covered all Marshall Islands south of Kwajalein and were conducted to determine whether winds at the 20,000-foot (6.1-km) level could have carried debris to the south and west and contaminated some of the southern Marshalls. The flights were executed on 3 March, but no significant ground contamination was found. An additional flight (designated King) covered the Gilbert Islands on 6 March for the same reasons. At the request of the task force, CINCPAC obtained advance clearance from the British for the Gilberts flight. A maximum of 0.00008 R/hr on 6 March was reported through CINCPAC to the U.S. Naval Attache in London (Reference 16, p. K-10).

Throughout the actions involving evacuation of island inhabitants, the standard reference used to determine whether an atoll was populated was OpNav 122-100-M, June 1951, Trust Territory of the Pacific Islands.

Because of the 18 people on Ailinginae (reported to be unpopulated), confirmation of the status of other atolls involved in significant fallout was obtained from the Trust Territory representative at Kwajalein. Of particular interest were Bikar and Taka for BRAVO fallout and Taongi for future shots. These atolls proved to be unpopulated as reported; the people on Ailinginae were not permanent residents, but only temporarily at Ailinginae to fish.

The offsite fallout findings, summarized by a member of the CTG 7.1 Advisory Group, are presented in Table 22.

PATAPSCO CONTAMINATION

The Patapsco, a gasoline tanker, was moored at Enewetak to unload aviation gasoline 2 days prior to the BRAVO detonation. The ship was ordered to leave and proceed at full speed from Enewetak to Pearl Harbor because it lacked adequate radiation equipment and protection gear. The ship's speed was reduced to one-third full speed on 28 February, however, because of a cracked cylinder liner. The ship was about 180 to 195 nmi (333 to 361 km) east of Bikini when BRAVO was detonated.

The ship had been vectored approximately along the BRAVO cloud hot line by the transient shipping search aircraft on D-day afternoon. In the early to mid-afternoon of the following day (H+31 to H+32.5), at a range of about 565 to 586 nmi (1,051 to 1,084 km) from ground zero, it began to receive fallout. The intensity of the fallout radiation is not accurately known. Flight Able reported that a little later in the afternoon Bikar (290 nmi 537 km east of Bikini) was reading about 0.600 R/hr. Estimates made by analysts working with the rates measured when the ship arrived at Pearl Harbor range from as high as 0.620 R/hr (Reference 85) to 0.183 R/hr (Reference 86).

No steps to decontaminate the ship were taken en route to Pearl Harbor because it appeared to those on board that the level of radiation was too low to cause concern. The ship arrived at Pearl Harbor on 7 March and was

MARSHALL ISLANDS POPULATION. Estimates for exposures to both U.S. personnel and Marshall Islanders were made in the Project 4.1 after-action report (Reference 65) and have been used here. The unevacuated population at Ailuk was not included in the Project 4.1 information, but it may be simply estimated by comparing the intensity of the readings made at Ailuk and nearby Utirik at nearly the same time on 2 March.

All of these have been summed up in Table 25, which presents the total collective exposure as a result of BRAVO and how it was distributed among groups. Comment on this table appears in Chapter 11.

RADIATION EFFECTS AND MEDICAL OBSERVATION OF TASK FORCE PERSONNEL

The Rongerik detachment of 28 that was evacuated to Kwajalein by air came in two groups, the first eight arriving at approximately 1400 hours and the second group at about 1830 hours.

Upon arrival the men were checked for the presence of radioactive materials on their bodies. There they showered to remove the material. The first group had from 7 to 11 showers and the second group had 5 each. The contamination present and the decontamination results of the showers are shown in Table 26.

After about a week at Kwajalein, the Air Force and Army personnel evacuated from Rongerik were returned to Enewetak Atoll (Reference 15):

It was decided by higher headquarters to bring the 28 personnel to Enewetak for further physical examination and to relieve the Kwajalein Hospital, whose facilities were limited in the field of radiological medicine, of the responsibility of those men. The first group arrived 8 March and the remainder followed the next day, and all were quartered in the Enewetak Post Infirmary where daily blood counts and physical checks were instituted.

On 17 March the group was moved back to Kwajalein to be "examined by specialists in radiological medicine in a location more remote from the possibility of future contamination" (Reference 15). However, on 13 March

Table 25. Summary of estimated fallout exposure for CASTLE, BRAVO.

Group	Persons	Mean Gamma Exposure (R)	Collective Exposure	
			(man-R)	(%)
JTF 7				
Headquarters	86 ^a	0.1 ^b	9	<1
Task Group 7.1				
Enewetak	520 ^c	0.1 ^b	52	<1
Bikini	485 ^c	0.5 - 2.4 ^d	447	1.4
Task Group 7.2	1,287 ^e	0.1 ^b	129	<1
Task Group 7.3	5,628 ^f	1 ^f	5,628	17.4
Task Group 7.4	1,725 ^g	0.1 ^{b, o}	173	<1
Task Group 7.5				
Enewetak	1,220 ^h	0.1 ^b	122	<1
Bikini	590 ^h	0.5 ^d	295	<1
Rongerik Detachment	28	78 ⁱ	2,184	6.7
Total JTF 7			9,039	27.9
Patapsco (AOG-1)	110 ^j	3.3 ^k	363	1.1
Total U.S.			9,948	30.7
Rongelap Marshall Islanders	64 ^l	175 ^l	11,200	34.6
Rongelap Islanders on Ailinginae	18 ^l	69 ^l	1,242	3.8
Utirik Marshall Islanders	157 ^l	14 ^l	2,198	6.8
Ailuk Marshall Islanders	401 ^l	4 ^m	1,604	5
Daigo Fukuryu Maru	23 ⁿ	290 ⁿ	6,670	20.6
Grand Total			32,316	100

Sources and Notes:

^aConsolidated List of CASTLE Radiological Exposures (Reference 13).

^bMicrofilm 5x8 cards (Reference 87, Index 1020 control film 4904-10).

^cTG 7.1 Installment History, May Installment, p. 20 (Reference 8).

^dMean of ships used in evacuation weighted by number of personnel (Ibid)

^eTG 7.2 History (Reference 10, April-May Installment).

^fTable 23 (Source: Reference 80).

^gCTG 7.4 Final Report (Reference 24).

^hCompletion Report (Reference 5, pp. 4-6, 4-7).

ⁱReference 64, p. 7.

^jMuster roll.

^kNOSC memo 25 Jan 1979 (Reference 86).

^lRadSafe Vol 2 (Reference 16).

^mEstimated as ratio of Utirik.

ⁿVoyage of Lucky Dragon (Reference 82, p. 158).

^oDoes not consider sampler aircraft crew.